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Claims

What is claimed is:

1. A stackable yarn dye tube comprising:

a hollow, cylindrical, central body having opposite ends and a plurality of perforating openings for passage of a coloring dye therethrough; and

first and second end portions respectively connected to the opposite ends of the central body, each of the first and second end portions including a substantially cylindrical ring connected to one of central body ends, the first and second end portions respectively including female and male elements at terminal ends thereof for nested engagement of adjacent tubes in a stack of aligned tubes,

the first end portion ring having inner and outer surfaces defining a wall thickness therebetween, the first end portion ring further including a plurality of recesses extending inwardly from the outer surface thereof and arranged in multiple rows extending circumferentially about the ring, each of the recesses defining a reduced wall portion of the first end portion ring having a thickness that is at least one-half of the wall thickness of the first end portion ring,

each of recesses of the first end portion ring being substantially oval in shape having arcuate ends for reducing stress concentrations in adjacent areas of the ring,

the female element of the first end portion including a cylinder extending from a terminal end of the first end portion ring, the cylinder of the female element having opposite inner and outer surfaces, the inner surface of the female element cylinder having a diameter that is greater than a diameter of the inner surface of the first end portion ring such that an annular distance is defined therebetween,

the terminal end of the first end portion ring defining a radially extending shoulder adapted for contact with the male element of an adjacent tube in a stack of aligned tubes,

the first end portion further including a fillet at the terminal end of the first end portion ring between the shoulder and the inner surface of the female element cylinder, the

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fillet extending inwardly from the female element cylinder over a substantial portion of the annular distance for reducing stress concentrations in adjacent portions of the first end portion ring and the female element cylinder.

2. The stackable yarn dye tube according to claim 1, wherein the thickness of each of the reduced wall portions defined by the recesses of the first end portion ring is greater than one-half of the wall thickness of the first end portion ring.

3. The stackable yarn dye tube according to claim 1, wherein the fillet of the first end portion extends from the female element cylinder over more than approximately 15 percent of the annular distance.

4. The stackable yarn dye tube according to claim 3, wherein the fillet of the first end portion extends from the female element cylinder over more than approximately 25 percent of the annular distance.

5. The stackable yarn dye tube according to claim 1, wherein the outer surfaces of the female element cylinder and the first end portion ring have diameters that are substantially equal.

6. The stackable yarn dye tube according to claim 1, wherein the central body includes inner and outer surfaces defining a wall thickness therebetween and wherein the perforating openings of the central body are arranged in circumferentially extending rows of openings, the central body further including a row of non-perforating recesses adjacent the first end portion ring, each recess of the central body defining a thin walled portion having a thickness that is less than approximately 25 percent of the central body wall thickness.

7. The stackable yarn dye tube according to claim 1, wherein the male element of the second end portion includes a cylinder connected to the ring of the second end portion, the male element cylinder including an inner surface having a diameter that is smaller than

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that of a cylindrical portion of the second end portion ring, and wherein a portion of the second end portion ring includes a tapered inner surface connecting the inner surfaces of the cylindrical portion of the second end portion and the male element cylinder.

8. The stackable yarn dye tube according to claim 7, wherein the female element cylinder of the first end portion and the ring of the second end portion include outer surfaces having substantially equal diameters providing for a flush nesting between adjacent tubes in an aligned stack of tubes.

9. The stackable yarn dye tube according to claim 7, wherein the male element of the second end portion includes an annular portion connected to a terminal end of the male element cylinder.

10. In a dye tube having a central body and female and male end portions for nested alignment of stacked tubes, the female end portion including a cylindrical ring connected to the central body and a female element connected to the ring, the female end portion ring having inner and outer surfaces defining a wall thickness therebetween, the female element having an inner surface that is greater in diameter than an inner surface of the ring to define an annular distance therebetween, a terminal end of the ring defining a radially extending shoulder for contact with the male end portion of an adjacent tube in an aligned stack of tubes, the improvement comprising:

a plurality of elongated recesses in the female end portion ring extending inwardly from the outer surface thereof to define reduced wall portions of the ring, each recess of the female end portion ring having a thickness that is at least approximately one-half of the ring wall thickness,

each of the recesses of the female end portion having opposite ends that are arcuate for reducing stress concentrations in adjacent areas of the ring; and

a fillet having opposite ends connected to the inner surface of the female element and the terminal end of the ring, the fillet extending over a substantial portion of the

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annular distance for reducing stress concentrations in adjacent areas of the female element and the ring.

11. The dye tube according to claim 10, wherein the fillet extends over more than twenty-five percent of the annular distance between the inner surfaces of ring and female element of the female end portion.

12. The dye tube according to claim 10, wherein the thickness of the recesses of the female end portion ring is greater than one-half the ring wall thickness.

13. The dye tube according to claim 10, wherein the central body includes a row of non-perforating recesses adjacent the ring of the female end portion, each of the recesses of the central body defining a reduced wall portion having a thickness that is less approximately 25 percent of a central body wall defined by inner and outer surfaces thereof.